

# NASA TECH BRIEF

## *Marshall Space Flight Center*



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### Interactive Graphical Computer-Aided Design System

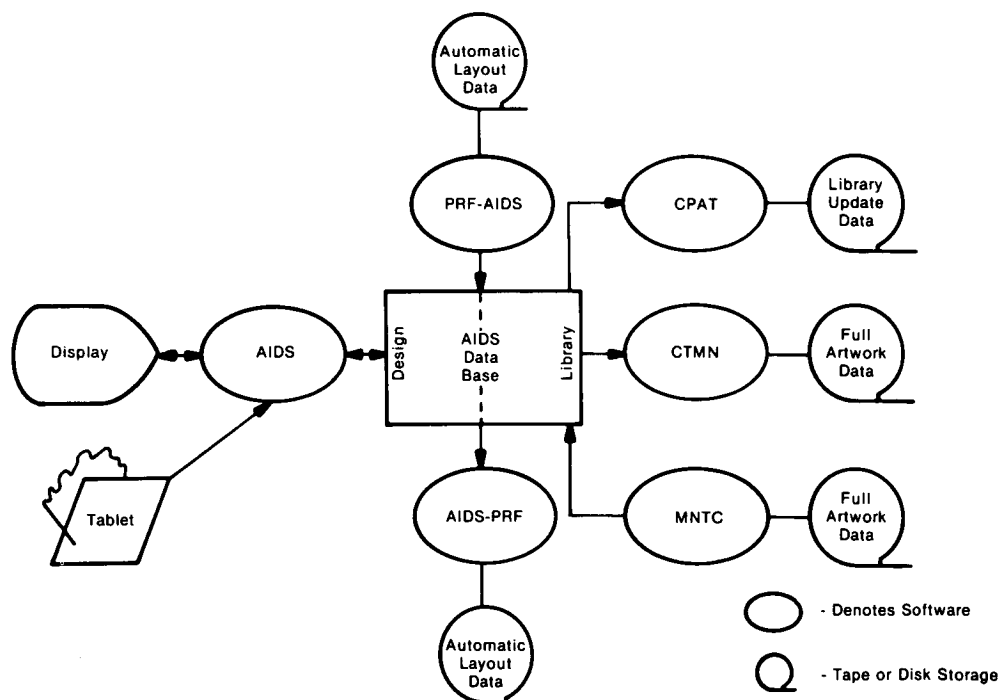
An interactive graphical computer-aided design system has been developed including supporting software. The system is used for the design, layout, and modification of large-scale-integrated (LSI) metal-oxide semiconductor (MOS) arrays.

This interactive graphics system is structured around a small general-purpose computer and its supporting peripherals, dedicated to providing real-time support for a graphics storage display unit with a keyboard, a slave display unit, a hard copy unit, and a graphics tablet for designer/computer interface. The designer sits at the graphics terminal using an inductive pen associated with the graphics tablet. A nonstoring cursor tracks the path of the pen about the tablet. The designer selects commands by applying pen pressure to designated areas of the tablet and

sends data to the computer by way of a data switch held in the other hand. The computer executes the commands given and reflects to the designer his graphical design needs. The designer can view portions of his work on the slave display unit while working with a different area on the master display. The designer also enters data through a keyboard and may obtain hard copies of the design.

The software network and communication flow of this interactive graphics system is shown in the illustration. The basic functions of the software systems are:

- AIDS (artwork interactive design systems),
- PRF-AIDS (place route fold - artwork interactive design systems),



Interactive Graphics Software and Communication Flow

(continued overleaf)

- c. AIDS-PRF (artwork interactive design systems - place parts fold),
- d. CPAT (cell pattern generation),
- e. CTMN (cell to mask tape), and
- f. MNTC (mask tape to cell).

AIDS is the center of the designer/computer software system. All actions at the tablet and terminal are focused through AIDS. When using AIDS, the designer steps through displays that allow the entering of data to establish design parameters prior to the design, such as component and line symbologies, the definitions of libraries and files, grid symbologies, and other commands for formatting. After these actions have been taken, the design field appears on the display, and the command menu attached to the tablet becomes active. Using the pen, commands are given to place, delete, name cells, add, copy, select levels, and scale, for the controlling of single items or groups of the design.

PRF-AIDS is a software conversion program that is executed prior to the execution of AIDS. This program converts data generated by the automatic layout program. Automatic layout output consists of all cell placement data, shape set data, and line set data that constitute the total chip design.

AIDS-PRF is a software program that is executed following AIDS. This program reads the AIDS data base and produces data in the format of the automatic layout data. It can be modified by the designer at the graphics terminal and recreated reflecting only the modifications performed. Thus the designer is given a chance to interrupt the normal flow of the custom LSI circuit design process and perform modifications that cannot be provided by automatic layout.

CPAT is a software program that is executed following the execution of AIDS. In this mode, AIDS is used to perform cell design. The cell designer approaches the graphics terminal with a thought, a sketch, or an accurate layout of the artwork that will eventually become a standard cell of a binary library if desired. AIDS is used to digitize the information into blocks and shapes that make up the artwork of the cell. Upon completion of the cell design, the data is filed into the AIDS data base. Executing CPAT accesses the desired cell from the AIDS library and generates library update source data. This source is used as an input to generate a standard cell binary library.

The CTMN conversion program allows the user to output data from the AIDS library data base into a format accepted by the mask pattern generator. Mask pattern generator data is the block artwork exposure information that constitutes the mask levels of the circuit. This is the data that is processed into photographic plates for fabrication of the circuit design. Thus the user has the capability of directly defining masks from the graphics terminal.

The MNTC conversion program provides the designer with a "last look" capability. The mask data tape is used as an input into the AIDS data base and is treated as a cell. AIDS can then be used to view the cell (total design) prior to the fabrication of the masks. AIDS is used to scan the masks in great detail at high gains for inspection and provides the designer with a matching group of hard copies to form a large mosaic of the total chip artwork. Acceptance of the chip design at this point releases the design to the mask facility.

These software packages were written in FORTRAN. Although FORTRAN causes some real-time degradation with respect to high-density graphics, it provides a standard base for the distribution of the system software to industry.

#### **Note:**

Requests for further information may be directed to:

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Reference: B75-10096

#### **Patent status:**

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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